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Risk of symptomatic venous thromboembolism following emergency appendicectomy in adults

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Background: Appendicectomy is the commonest intra-abdominal emergency surgical procedure and little is known regarding the magnitude and timing of the risk of venous thromboembolism (VTE) after surgery. This study aimed to determine absolute and relative rates of symptomatic VTE following emergency appendicectomy.

Methods: A cohort study using linked primary (Clinical Practice Research Datalink) and secondary (Hospital Episode Statistics) care data of patients who had undergone emergency appendicectomy from 2001 to 2011 was undertaken. Crude rates and adjusted incidence rate

ratios (IRRs) for VTE were calculated using Poisson regression, compared with baseline risk in the year before appendicectomy.

Results: A total of 13 441 patients were identified, of whom 56 (0.4 per cent) had a VTE in the first year after surgery. The absolute rate of VTE was highest during the in-hospital period, with a rate of 91.29 per 1000 person-years, which was greatest in those with a length of stay of 7 days or more (267.12 per 1000 person-years). This risk remained high after discharge, regardless of length of stay, with a 19.0- and 6.5-fold increased risk of VTE in the first and second months respectively after discharge, compared with the year before appendicectomy (adjusted IRR: month 1, 19.09 (95 per cent c.i. 9.56 to 39.12); month 2, 6.56 (2.62 to 16.44)).

Conclusion: The risk of symptomatic VTE following appendicectomy is high during the in-hospital period and remains increased after discharge. This suggests that trials of extended thromboprophylaxis are warranted in patients and time periods at particularly high risk.

+A: Introduction

There are approximately 300 000 diagnoses of appendicitis in the USA each year and 40 000 in England, making it the most common abdominal emergency requiring surgical intervention[1–4]. Current studies[5–7] reporting the risk of venous thromboembolism (VTE) following appendicectomy are limited to in-hospital events, are not population-based, or focus only on pulmonary embolism. Only one previous study[8] has reported incidence as long as 91 days after surgery and discharge; however, the study used data from the early 1990s and failed to describe excess risk of VTE or define high-risk periods or patients. Given that there have been marked changes in the surgical management of these patients, with an increased use of laparoscopy and an associated decrease in the duration of hospital stay, the at-risk

period for VTE may have altered[5,8,9]. The recent 2010 National Institute for Health and Care Excellence (NICE)[10] and 2012 American College of Chest Physicians[11] guidelines specifically highlight the lack of data on the risk of VTE following general surgical procedures, in particular regarding the timing of these events and those most at risk. This information is required to direct thromboprophylactic strategies to the appropriate at risk periods and high-risk patients. This study aimed to report the rates of symptomatic VTE following emergency appendicectomy using population-based, linked primary and secondary care data from England.

+A: Methods

The study had approval from the Independent Scientific Advisory Committee approval board (Protocol 11-051R).

+B: Clinical Practice Research Database

The Clinical Practice Research Database (CPRD) contains diagnostic and prescription data for approximately 13 million of the general population in the UK, with 3.4 million active patients contributing data. Diseases are coded within the CPRD using Read codes, which have been used by clinicians to record data within primary care since 1985[12].

Hospital Episode Statistics

Hospital Episode Statistics (HES) collects a record for each 'episode' of admitted patient care delivered in England, either by National Health Service (NHS) hospitals or delivered in the independent sector but commissioned by the NHS. HES has collected data since 1989, with more than 15 million new records added each year. Records are coded using a combination of ICD-10 for diagnosis at discharge along with Office of Population, Censuses and Surveys Classification of Surgical Operations and Procedures (OPCS 4) detailing procedures performed. HES data are being used increasingly to study surgical diseases, with a recent

systematic review[13] reporting that approximately two-thirds of studies published using this concern surgical conditions.

Death certificate data from the Office for National Statistics (ONS) were also used. The anonymized patient identifiers from CPRD and HES were linked by a trusted third party by using the NHS number, date of birth, postcode and sex. Most patients were matched exactly according to NHS number (over 90 per cent of patients are linked in this way), with the remaining patients linked probabilistically on the basis of postcode, date of birth and sex. In the version used, 53 per cent of practices in the CPRD are linked to HES, which represents a 3 per cent sample of the English population. These data have been shown previously to be similar in terms of age, sex and geographical distribution to data from the UK population[14].

+B: Cohort identification

The cohort was identified from CPRD–HES-linked data using OPCS 4 codes for appendicectomy (codes H011, H012, H013, H018, H019, H028, H029, H031, H032, H038, H039). A laparoscopic approach was confirmed by the inclusion of an OPCS code for laparoscopy (Y508, Y751 and Y752). Only those patients coded as having an emergency procedure via their admission type were included. Patients who had a prophylactic, incidental or interval appendicectomy (492 of 13 933, 3.5 per cent) were excluded from the analysis. All patients under the age of 18 years were excluded, as the risk of VTE in this group is inherently low. Patients were excluded if they were not in a linked general practice.

+B: Outcome definition

The outcome was considered to be a VTE event if supported by either: a prescription for an anticoagulant or other evidence of treatment in an anticoagulation clinic (such as a medical code) between 15 days before and 90 days after the VTE diagnosis, or a date of death within 30 days of the event for which the cause of death was VTE. Only the first validated instance

of VTE was included in the analysis. The definition using primary care data alone has been validated previously[15]; 84 per cent of cases were valid and used in previous studies of VTE[16,17].

+B: Exposures

Co-morbidity was determined from the CPRD and classified using the Charlson index before admission for surgery, and categorized as: no co-morbidity, one co-morbidity, or two or more co-morbidities[18]. Operation type was classified as either laparoscopic, open or converted laparoscopic, as indicated by the presence of OPCS code Y714. Body mass index (BMI) was defined from the primary care data and classified as less than 30 kg/m^2, 30 kg/m^2 or above, or missing. A diagnosis of appendicitis at discharge was confirmed from the associated ICD-10 codes for that admission confirming appendicitis, and included K35.0, K35.1, K35.9, K36, K37, K38.8 and K38.9. Finally, the duration of hospital stay for each admission was calculated and categorized into percentiles based on length of stay (0–4, 5–6, 7–9 and 10 days or more, representing the 0–74th, 75–89th, 90–94th and 95–100th percentiles respectively). Current use of anticoagulation with warfarin and use of the oral contraceptive pill was identified from primary care prescriptions.

+B: Statistical analysis

All data management and analysis were performed using Stata® 12 (StataCorp, College Station, Texas, USA). All basic characteristics of the study population were assessed using frequencies and percentages. Person-years at risk were calculated from 1 year before appendicectomy to the end of follow-up, defined as developing a VTE event, death or transfer out of general practice. The time was then divided into 1 year before appendicectomy, in-hospital period, monthly for the following 3 months, and then the interval up to 1 year. Absolute rates of VTE per 1000 person-years in the first year after appendicectomy were calculated. All VTEs recorded on the same day as the operation were also included in the

analysis. The above calculated rates were then stratified by different co-variables (age, sex, duration of hospital stay, operation type (laparoscopic or open) and appendix histology (perforated or non-perforated)), and their impact on the risk of VTE was assessed in terms of incidence rate ratios (IRRs) compared with the reference category (for each co-variable) using a Poisson regression model. An interaction between length of stay (less than 7 days, and 7 days or more) and risk of VTE after discharge compared with that in the year before surgery was tested for using a likelihood ratio test. To assess the impact of timing in relation to index surgery on the risk of VTE, rates of VTE within hospital admission during which the index surgery was conducted and during the postdischarge period (defined from the date of discharge to exit from the study, defined as death, last data collection or VTE) were calculated. The postdischarge period was further stratified into individual months up to 2 months. A further analysis by weeks after surgery up to 12 weeks after discharge was undertaken, given the increased risk of VTE following gastrointestinal surgery previously reported in the Million Women Study[19]. Finally, the risk of VTE within 1 year before surgery was examined and compared with the risk after surgery by means of Poisson regression.

+A: Results

In total, 13 441 patients were identified who underwent appendicectomy during the study interval, with 56 (0.4 per cent) having a VTE in the first year after surgery. Some 6713 (49.9 per cent) of the patients were men (*Table 1*). The median age at appendicectomy was 33 (i.q.r. 24–46) years. The majority of patients (9546, 71.0 per cent) had no co-morbidity and a Charlson score of 0. Most had an open procedure; however, the proportion of laparoscopic operations increased each year, reaching 56.0 per cent (691 of 1234) by 2011. The median duration of hospital stay was 3 (i.q.r. 2–4) days following a laparoscopic procedure and 3 (2–5) days after an open procedure. In 85.9 per cent of patients (11 543 of 13 441), a diagnosis of appendicitis was confirmed on discharge from hospital. In total, 67 patients (0.5 per cent) had

a previous history of long-term anticoagulation, but none of these developed a VTE. Some 13.8 per cent of the women were current users of the oral contraceptive pill.

+B: Absolute and relative rates of venous thromboembolism after appendicectomy

The absolute rate of VTE in the year after appendicectomy was 4.73 (95 per cent c.i. 3.64 to 6.15) per 1000 person-years. Increased age, an increased BMI and a prolonged length of stay were associated with an increased VTE risk, whereas current use of the oral contraceptive pill was not. Absolute rates of VTE increased with increasing age, peaking in those over 60 years old (absolute rate 17.68 (95 per cent c.i. 11.53 to 27.12) person-years), which represented an adjusted 2.6-fold increase in risk compared with that in patients aged less than 40 years (*Table 2*). Patients with a length of stay greater than 10 days (95th percentile) had a 14.2-fold increased risk of VTE compared with those with a hospital stay of 4 days or less (75th centile) (adjusted IRR 14.22, 6.78 to 30.28).

The absolute rate of VTE increased with increasing levels of co-morbidity, with the highest rate in patients with a Charlson score of 2 or more (absolute rate 13.24 (95 per cent c.i. 7.33 to 23.90). This represented a crude 3.2-fold increased risk in comparison with those with no co-morbidity; however, this association was lost completely when age was taken into accounting (adjusted IRR 0.97, 0.46 to 2.04), as patients with a Charlson index of 0 had a median age of 33 (i.q.r. 24–44) years compared with of 55 (40–69) years in those with a Charlson score of 2 or more. Patients having an open appendicectomy had a greater absolute rate of VTE than those who underwent a laparoscopic procedure (5.22 *versus* 2.74 per 1000 person-years). However, this association was attenuated when accounting for other factors (adjusted IRR 1.21, 0.53 to 2.73) (*Table 2*).

Timing of venous thromboembolism after surgery

The absolute rate of VTE following appendicectomy was highest in the in-hospital period, with an absolute rate of 91.29 per 1000 person-years, which represented a 47.5-fold increased risk of VTE compared with that in the year before appendicectomy (adjusted IRR 47.51, 95 per cent c.i. 22.62 to 99.78) (*Table 3*). After discharge, the absolute rate of VTE was highest in the first 2 months (19.59 and 6.69 per 1000 person-years in months 1 and 2 respectively). Accounting for age, sex, duration of hospital stay, co-morbidity, perforation and operation type, this represented an independent 19.1- and 6.6-fold increased risk respectively, compared with the year before surgery. After the second month the rate of VTE fell, with no increased risk compared with that in the year before surgery by the third month after discharge (adjusted IRR 1.14, 0.51 to 2.55).

An interaction between duration of hospital stay and the timing of the VTE event was identified ($P < 0.001$, likelihood ratio test). Patients with a length of stay of less than 7 days had an 8.3-fold increased risk (IRR 8.30, 95 per cent c.i. 1.06 to 64.82), whereas those with a length of stay of 7 days or more had a 129.0-fold increase in risk compared with that in the year before hospital admission (adjusted IRR 128.96, 37.49 to 443.55) (*Table 4*). However, after discharge the patterns of increased risk remained constant even when stratifying by duration of hospital stay, with a 12.8-fold (adjusted IRR 12.77, 5.42 to 30.07) and 40.2-fold (adjusted IRR 40.17, 11.06 to 145.55) increase in VTE risk following discharge compared with that in the year before surgery in those with a hospital stay of less than 7 days and of 7 days or more respectively. When refitting the model without length of stay there was a 19.0-fold and 6.5-fold increased risk in VTE in the first and second month after discharge respectively, compared with the year before surgery (adjusted IRR 19.03, 9.53 to 38.01, and 6.51, 2.60 to 16.31, respectively).

The absolute rates of VTE in each week after the in-hospital stay following appendicectomy are shown in *Fig. 1*. Rates were highest in the first 2 weeks after discharge

(31.50, 95 per cent c.i.15.75 to 62.99, and 27.87, 13.29 to 58.46, per 1000 person-years in weeks 1 and 2 respectively), declining to baseline by 12 weeks.

+A: Discussion

Overall, 0.4 per cent of the patients developed a symptomatic VTE in the first year after appendicectomy. The absolute rate around the time of surgery was greatest during the in-hospital period immediately following appendicectomy, especially in those with a hospital stay of more than 1 week. In the month after discharge there was an approximately 19-fold increase in risk of VTE, independent of age, sex, co-morbidity, appendix histology and mode of surgery compared with the risk before the operation. The absolute risk following discharge was highest in the first and second weeks after discharge, and returned to baseline risk about 3 months after appendicectomy.

This study used linked data to identify patients undergoing appendicectomy from population-based data, with identification of operative procedures from secondary care along with the definition of VTE in a validated manner from primary[15] and secondary care; in that sense it is uniquely placed to quantify VTE risk accurately. The identification of VTE in these data following discharge relies on clinical suspicion by the general practitioner and subsequent referral for investigation, thereby minimizing the surveillance bias that may occur in patients identified solely in hospital, as has been suggested in other studies[20]. Although the rates of laparoscopic surgery reported were slightly low overall in the final year of the study, this was 56.0 per cent of all appendicectomies carried out in 2011 and, with a near 8 per cent year-on-year increase, this approaches the values for laparoscopic surgery reported in the UK National Appendicectomy audit[9], of 66 per cent in 2012. These rates of laparoscopic surgery are greater those reported from other European countries (33 per cent in 2008)[21], but lower than those reported from the USA where 82 per cent of cases were performed

laparoscopically in 2008[22]. The reported rate of negative appendicectomy is in line with previously reported data using HES[23]; however, a previous study[24] of the use of discharge OPCS codes for appendicectomy reported 14 per cent of patients were incorrectly coded as having appendicitis when in fact they had a histologically normal appendix. That study reported a negative appendicectomy rate of 24 per cent, compared with that in the present study of 14.1 per cent. In the analysis it was not possible to identify patients who received thromboprophylaxis; however, there were no recommendations for extended prophylaxis following appendicectomy during the study interval. Furthermore, rates of VTE prophylaxis in emergency patients in 2007 were low, with only 50 per cent of emergency patients receiving appropriate prophylaxis[25]. NICE guidelines on VTE prevention in surgical patients were published in 2007 and revised in 2010, and the latter guidelines[10] advised pharmacological and mechanical prophylaxis in all 'at risk' surgical patients, with the definition including those who required appendicectomy.

This study was designed to detect symptomatic VTE. However, it is widely recognized that up to 80 per cent of hospital-acquired thrombotic events are clinically silent[26], and, moreover, that cases of VTE are missed, as shown by autopsy studies, owing to failure to consider it in differential diagnosis. This suggests that the incidence rates of all VTE events following appendicectomy is probably higher than those described in the present study.

The median duration of hospital stay after appendicectomy was comparable to that reported in studies from Japan, Sweden and the USA using population-based data[21,22,27]. The associated increase observed in the risk of VTE with increasing length of stay may be due to a diagnosis of VTE delaying discharge. However, as only the first reported VTE event has been used, it is important to note that, when the analysis was stratified by length of hospital stay, the risk of VTE remained increased after discharge even in those with a hospital stay of more than 1 week.

Masoomi and colleagues[5] reported an in-hospital risk of both deep vein thrombosis (DVT) and pulmonary embolism (PE) following appendicectomy of 0.02 per cent when performed laparoscopically, and of 0.04 per cent for DVT and 0.01 per cent for PE following open surgery, in patients with a non-perforated appendix. Following perforation of the appendix, they reported a rate of 0.08 per cent following laparoscopic surgery for both DVT and PE. For appendicectomies performed by an open procedure after perforation, the rate was 0.18 per cent for DVT and 0.12 per cent for PE using data from the Nationwide Inpatient Sample from the USA[5]. In this study, a 2.0-fold higher rate of VTE was in observed in patients undergoing open surgery compared with the laparoscopic cohort, although this was not statistically significant. According to an analysis of the Swiss Association of Laparoscopic and Thoracoscopic Surgery database[7], the in-hospital rate of PE was 0.25 per cent following 5526 appendicectomies. A Swedish study[28] of deaths after 119 060 appendicectomies recorded in the National Inpatient Register reported 15 (0.01 per cent) fatal pulmonary emboli following appendicectomy. The in-hospital rate of VTE reported of 0.13 per cent (17 of 13 441) is therefore approximately in the middle of the reported range of incidence rates. Importantly, the previous studies failed to identify specific patient groups at increased risk of VTE, and did not estimate the excess risk compared with any within-person baseline period, unlike this study.

Few previous data have been reported on the timing of symptomatic VTE following appendicectomy. Rather, reports have focused on all general surgical procedures or VTE risk in other surgical specialties such as orthopaedics or obstetrics. The Million Women Study[19] did report an increased risk of VTE after gastrointestinal surgery in middle-aged women, but did not report rates by individual procedures. One previous study[8] reported a 0.2 per cent incidence of VTE following appendicectomy at 91 days, but failed to define the highest risk periods or the patients at greatest risk. Warwick and co-workers[29] studied rates of VTE after

orthopaedic surgery and described a peak of symptomatic VTE after total hip replacement at 21.5 days, and 9.7 days after total knee replacement. This continued increase in risk of VTE beyond discharge is also seen after caesarean section (absolute rate 14.25 per 1000 person-years *versus* 19.59 per 1000 following appendicectomy), for which there is clear guidance to continue thromboprophylaxis for 7 days after discharge[30].

Appendicitis remains the most common intra-abdominal emergency requiring surgical intervention. Reassuringly, rates of VTE following appendicectomy are low, although patients with a prolonged hospital stay are at increased risk and their risk should therefore be reassessed during the inpatient stay. Patients remain at increased risk of VTE for up to 2 months after discharge from hospital, with the peak increase in the first 2 weeks.

These findings imply that after an emergency appendicectomy patients and their surgeons should be aware of the ongoing risk of VTE, and preventive strategies, as used following obstetric or orthopaedic surgery, may be warranted. Trials of extended thromboprophylaxis in specific high-risk patient groups, such as the elderly, or time periods, for instance in the first 2 weeks after hospital discharge, should be considered to assess the benefit in terms of VTE risk reduction in comparison with any potentially increased bleeding risk.

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<TYPESETTER: PLEASE FOLLOW MARK-UP OF FIG. 1>

Fig. 1 Rates of venous thromboembolism (VTE) in the 12 weeks following appendicectomy. Error bars denote 95 per cent c.i.

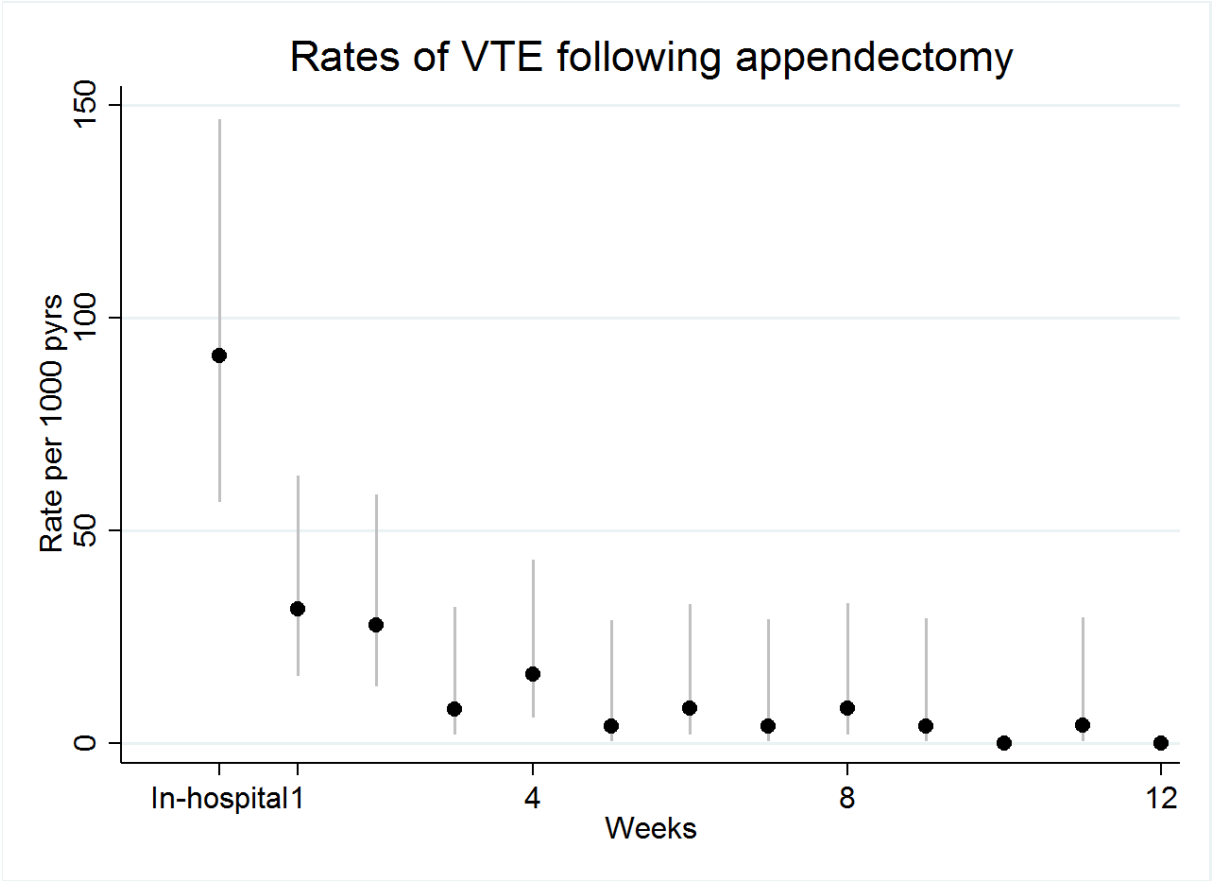
Rates of VTE following appendectomy
Rate per 1000 pyrs
0
50
100
150
In-hospital
1
4
8
12
Weeks

Table 1 Demographics of the appendicectomy cohort

	No. of patients (n = 13 441)
Age (years)	
18–39	8584 (63.9)
40–49	2136 (15.9)
50–59	1320 (9.8)
≥ 60	1401 (10.4)
Sex ratio (M : F)	6713 : 6728
No. of co-morbidities	
0	9546 (71.0)
1	2904 (21.6)
≥ 2	991 (7.4)
Body mass index (kg/m^2)	
< 30	7710 (57.4)
≥ 30	2077 (15.5)
Missing	3654 (27.2)
Duration of hospital stay (days)*	
0–4 (0–74)	10 050 (74.8)
5–6 (75–89)	1708 (12.7)
7–9 (90–94)	955 (7.1)
≥ 10 (95–100)	728 (5.4)
VTE	
No	13 385 (99.6)
Yes	56 (0.4)
Laparoscopic procedure	
Yes	3139 (23.4)
No	9979 (74.2)
Converted	323 (2.4)
Appendicitis	
Yes	11 543 (85.9)
No	1898 (14.1)
Perforated appendix	
No	8687 of 11 543 (75.3)
Yes	2856 of 11 543 (24.7)

Values in parentheses are percentages, except *values are percentiles. VTE, venous thromboembolism.

Table 2 Analysis of rates of venous thromboembolism in the first year after appendicectomy for different risk factors

	No. of events	Time (years)	Absolute rate (per 1000 person-years)	Univariable IRR	Multivariable IRR*
Age (years)					
18–39	18	7.51	2.40 (1.51, 3.80)	1.00 (reference)	1.00 (reference)
40–49	8	1.94	4.12 (2.06, 8.25)	1.72 (0.75, 3.96)	1.20 (0.51, 2.82)
50–59	9	1.19	7.55 (3.93, 14.50)	3.15 (1.42, 7.02)	1.61 (0.69, 3.78)
≥ 60	21	1.19	17.68 (11.53, 27.12)	7.38 (3.93, 13.85)	2.58 (1.21, 5.52)
Sex					
M	28	5.91	4.74 (3.27, 6.86)	1.00 (reference)	1.00 (reference)
F	28	5.92	4.73 (3.27, 6.85)	0.99 (0.59, 1.68)	0.94 (0.55, 1.60)
BMI (kg/m^2)					
< 30	28	6.78	4.13 (2.85, 5.98)	1.00 (reference)	1.00 (reference)
≥ 30	17	1.81	9.4 (5.84, 15.12)	2.27 (1.25, 4.15)	1.93 (1.05, 3.55)
Missing	11	3.25	3.39 (1.88, 6.12)	0.82 (0.41, 1.65)	1.14 (0.56, 2.35)
Co-morbidity					
0	35	8.46	4.14 (2.97, 5.76)	1.00 (reference)	1.00 (reference)
1	10	2.55	3.93 (2.11, 7.30)	0.95 (0.47, 1.92)	0.76 (0.37, 1.56)
≥ 2	11	0.83	13.24 (7.33, 23.90)	3.20 (1.62, 6.30)	0.97 (0.46, 2.04)
Duration of hospital stay (days)					
0–4	16	8.86	1.81 (1.11, 2.95)	1.00 (reference)	1.00 (reference)
5–6	8	1.52	5.27 (2.63, 10.53)	2.92 (1.25, 6.82)	2.48 (1.04, 5.93)
7–9	10	0.84	11.90 (6.40, 22.12)	6.60 (2.99, 14.53)	5.32 (2.30, 12.31)
≥ 10	22	0.61	36.05 (23.74, 54.75)	19.97 (10.49, 38.02)	14.22 (6.78, 30.28)
Type of surgery					
Laparoscopic	7	2.56	2.74 (1.30, 5.74)	1.00 (reference)	1.00 (reference)
Open	47	9.01	5.22 (3.92, 6.94)	1.91 (0.86, 4.22)	1.21 (0.53, 2.73)
Appendicitis					
No	7	1.66	4.22 (2.01, 8.86)	1.00 (reference)	1.00 (reference)
Yes	49	10.18	4.81 (3.64, 6.37)	1.14 (0.52, 2.52)	1.02 (0.44, 2.35)
Histology of appendix					
Non-perforated	38	9.35	4.06 (2.96, 5.59)	1.00 (reference)	1.00 (reference)
Perforated	18	2.49	7.24 (4.56, 11.50)	1.78 (1.01, 3.12)	0.69 (0.37, 1.27)

Values in parentheses are 95 per cent c.i. *Adjusted for all factors in the table. IRR, incidence rate ratio; BMI, body mass index.

Table 3 Analysis of rates of venous thromboembolism in the year before appendicectomy, during hospital admission, and in the months after surgery

	No. of events	Time (years)	Absolute rate (per 1000 person-years)	Univariable IRR*	Multivariable IRR*†
Before surgery	13	12.38	1.05 (0.61, 1.81)	1.00 (reference)	1.00 (reference)
Hospital in-patient	17	0.19	91.29 (56.75, 146.85)	86.94 (42.23, 178.99)	47.51 (22.62, 99.78)
After surgery					
Month 1	21	1.07	19.59 (12.78, 30.05)	18.66 (9.34, 37.27)	19.09 (9.56, 38.12)
Month 2	7	1.05	6.69 (3.19, 14.04)	6.37 (2.54, 15.98)	6.56 (2.62, 16.44)
Up to 12 months	9	8.50	1.06 (0.55, 2.03)	1.09 (0.49, 2.45)	1.14 (0.51, 2.55)

Values in parentheses are 95 per cent c.i. *Poisson model; †adjusted for sex, age, body mass index, duration of hospital stay, co-morbidity, appendix histology and operation type. IRR, incidence rate ratio.

Table 4 Analysis of risk of venous thromboembolism during hospital admission and in the months after appendicectomy compared with the year before surgery, stratified by duration of hospital stay

	Incidence rate ratio*	
	Hospital stay < 7 days	Hospital stay ≥ 7 days
Before surgery	1.00 (reference)	1.00 (reference)
Hospital in-patient	8.30 (1.06, 64.82)	128.96 (37.49, 443.55)
After surgery		
Month 1	12.77 (5.42, 30.07)	40.17 (11.06, 145.98)
Month 2	4.74 (1.48, 15.10)	12.59 (2.54, 62.36)
Up to 12 months	1.02 (0.41, 2.61)	1.42 (0.29, 7.03)

Values in parentheses are 95 per cent c.i. *Adjusted for sex, age, body mass index, duration of hospital stay, co-morbidity, appendix histology and operation type.